DETAILED ACTION

Claim Objections

1. **Claims 1 and 2** are objected to because of the following informalities: "so as to inhibit worsening in initial characteristics thereof" is subject to multiple interpretations. The Examiner interprets this in light of the disclosure such that natural vegetable materials are prone to molding, rotting and decomposing and treatment with a crosslinking polymer is meant to ameliorate the tendency for said vegetable articles to do so. Appropriate correction is required.

Claim Rejections - 35 USC § 112

2. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

3. **Claims 6 and 7** are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

It is unclear what is meant by "fiber aggregate except for a fruit or a husk and a peel of the fruit and a general-use natural cellulose fiber." The instant claim language is vague in the sense that it is not fully understood what types of fibers are included or excluded by the claim. The disclosure teaches that the "vegetable article in the present invention is a leaf, a stem, a trunk, a vine, a fruit, a husk and a fiber aggregate collected therefrom of a plant such as rush grass, rice plant, luffa, buckwheat, soybean, bamboo, timber or sea grass as a material" and all provided examples utilize whole husks and grass. Furthermore, "general-use natural cellulose fibers" are taken to be defined as cotton, hemp, and linen as disclosed. However, the claim, as

written suggests the vegetable article comprises anything but the husks, peels and general-use natural cellulose fibers.

Claim Rejections - 35 USC § 102

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

5. **Claims 1-2 and 10 are rejected under 35 U.S.C. 102(b) as being anticipated by Wataya (JP 08-025319 A) as evidenced by *Chemical Modification of Lignocellulosic Materials* (Chapters 1 and 9; R.M. Rowell, D.S. Hon, editor; Marcel Dekker, Inc., 1996).**

(Claims 1-2 and 10) Wataya teaches treatment of vegetable fibers *('319, translated par. [0016])* with a self-crosslinking polymer (acrylate copolymer emulsion) in order to produce resilient fiber boards for building materials *('319, translated Abstract; translation par. [0015-0016]).*

As evidenced by *Chemical Modification of Lignocellulosic Materials*, vegetable articles derived from wood and other plants contain lignocellulosic polymeric composites made up primarily of cellulose, hemicelluloses and lignin *(Chapter 1, page 3, first par.)*. These polymeric composites are characterized by hydroxyl and other oxygen-containing groups that attract moisture through hydrogen bonding. It is due to moisture, oxidation, microorganisms and ultraviolet light that vegetable articles biodegrade, i.e. the initial characteristics worsen. However, it is replete in the art that chemical modifications, particularly of the hydroxyl group,

such as through polymer formation crosslinking can yield good biological resistance (partially due to the unavailability of the hydroxyl groups and thus a decrease in water absorption through hydrogen bonding) and the bulking action of the polymer gives the added property of dimensional stabilization *(Chapter 1, page 5; Chapter 9, pages 231-234)*.

Therefore, Wataya discloses both a process **(Claim 2)** and vegetable article **(Claim 1)** and product **(Claim 10)**, e.g. fiberboard, involving a crosslinking reaction by using a crosslinking agent where, as evidenced by *Chemical Modification of Lignocellulosic Materials,* the characteristics or tendency of the natural vegetable material to worsen (e.g. rot, decompose) are inhibited through treatment with a self-crosslinking polymer.

6. **Claims 1-2 and 10 are rejected under 35 U.S.C. 102(b) as being anticipated by Heiko et al. (JP 07-040312 A) as evidenced by *Merriam-Webster's Dictionary* ("wood." <http://www.merriam-webster.com/dictionary/wood>) and *Chemical Modification of Lignocellulosic Materials* (Chapters 1 and 9; R.M. Rowell, D.S. Hon, editor; Marcel Dekker, Inc., 1996).**

(Claims 1 and 2) Heiko teaches the treatment of wood with a crosslinking agent to prevent moisture accumulation and thus make the wood waterproof *(translated Abstract; translated par. [0006])*. As defined in Merriam-Webster's dictionary, wood is a fibrous substance derived from stems, branches, and roots of trees or shrubs and is found to a limited extent in herbaceous plants. As evidenced above in *Chemical Modification of Lignocellulosic Materials,* it is well known in the art that water (moisture content) acts to promote biodegradation (e.g. mildew, rot, fungi, bacteria) of natural articles, hence "waterproofing" via

crosslinking as taught by Heiko inhibits this process. Therefore, Heiko teaches a vegetable article **(Claim 1)** and product comprising the vegetable article **(Claim 10)**, e.g. soundboards *('312, translated par. [0021])*, which has been subjected to a crosslinking reaction process **(Claim 2)** so as to inhibit worsening in initial characteristics thereof.

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

3. **Claims 3-9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wataya (JP 08-025319 A) and Heiko et al. (JP 07-040312 A) in view of *Chemical Modification of Lignocellulosic Materials* (Preface and Chapters 1, 11, 13, 14; R.M. Rowell, D.S. Hon, editor; Marcel Dekker, Inc., 1996).**

(Claims 3-5) Wataya teaches the vegetable article of Claim 1, wherein the vegetable article has been subjected to a crosslinking reaction by using a crosslinking agent (see above).

Wataya fails to specifically disclose:

a. **Claim 3:** the moisture content change index after washing and dehydration of a crosslinked versus an uncrosslinked vegetable article

b. **Claim 4:** the bulk density change index before washing and after washing and drying of a crosslinked versus an uncrosslinked vegetable article

c. **Claim 5:** the lightness change index before washing and after washing crosslinked versus an uncrosslinked vegetable article

However, ***Chemical Modification of Lignocellulosic Materials*** teaches:

d. With respect to **Claims 3-5 in general**, the chemical modification conditions must take into account intrinsic product properties, new product application properties including tensile and compressive strength; elastic, tensile, and compressive moduli; density; thermal stability; electrical conductivity; biodegradability; weatherability; and dimensional stability *(Chapter 1, page 7, first par.)* and the cellular structure of the vegetable article greatly depends on the type of crosslinking agent used and the conditions under which the reaction occurs, for example crosslinking can join two hydroxyl groups or can introduce a bulking agent between these hydroxyl groups *(Chapter 13, Fig. 1, page 313)*

e. More specifically, with respect to **Claim 3**, the relationship between chemical modification and cell wall moisture content at equilibrium is reduced by about half and that modifications such as crosslinking have a greater reducing effect than alternative modifications *(Chapter 11, page 297, par. B., lines 1—3 and page 298, lines 1-3).* Furthermore, the ability for the crosslinked vegetable article to absorb or be impervious

to water depends on the moisture content of the vegetable article at the time of crosslinking and the conditions of the crosslinking reaction *(Chapter 13, page 327)*.

f. With respect to **Claim 4**, chemical modifications as noted above highly depend on (1) the physical properties of the vegetable article to be modified and (2) the reaction conditions. However, in general, cell wall volume of the vegetable article increases upon crosslinking, particularly if a bulking agent is introduced, and thus the number of fibers per cross-sectional area in a crosslinked vegetable article will be reduced hence decreased bulk density *(Chapter 11, page 298, par. C)*. As discussed above (see Claim 3), the crosslinked vegetable article does not absorb as much water. Furthermore, it is replete in the art that crosslinking a vegetable article with either formaldehyde or alternative non-toxic crosslinking agents, greatly improves the "anti-swelling efficiency" of said article *(Chapter 14, pages 336-340)*.

g. With respect to **Claim 5**, "weathering is defined as a result of a complex combination of processes involving the effects of light, water, fungi, and airborne dirt and pollutants…in general wood surfaces take on a grey color and may support molds or fungal staining organisms over a period of time" *(Chapter 11, page 277)* where some of the key factors causing weathering appear to be UV light and water and possibly visible light *(Chapter 11, page 282, par. 2)*. Discoloration or change in lightness of a vegetable article is also greatly attributed to the relative lignin content of the article where breakdown of lignin to water-soluble reaction products gradually wear away from the article and leave the article rich in other components such as cellulose *(Chapter 11, page 282, par. 2)*. As noted above, crosslinking improves the water resistance and anti-

swelling properties of a vegetable article and therefore the anti-"weathering" properties due to the effects of water, and it is known in the art that treating the vegetable article with a polymer that can be crosslinked can reduce weathering through reduced water uptake and gradual leaching of lignin by-products *(Chapter 11, page 286, polymethyl methacrylate [PMMA] improves anti-weathering properties)*.

Therefore, **Wataya ('319) and Heiko ('312)** teach a crosslinked vegetable article that, in view of *Chemical Modification*, will have a greater resistance to swelling and deformation and a moisture content after washing and dehydration smaller than that of the uncrosslinked vegetable article **(Claim 3)**. Additionally, Wataya and Heiko in view of *Chemical Modification* teach a crosslinked vegetable article wherein the change in a bulk due to washing is smaller than the uncrosslinked vegetable article because the crosslinking reaction: (1) reduces the overall density of fibers within the vegetable article and (2) reduces the amount of water absorbed by the article after washing, thus the bulk density of the crosslinked vegetable article taught by Wataya and Heiko will change less per unit of fiber than that of the uncrosslinked vegetable article by comparison **(Claim 4)** and has a lightness index change in response to elements known to cause weathering (e.g. water/washing) smaller than that of an uncrosslinked vegetable article **(Claim 5)**. Thus Wataya and Heiko in view of *Chemical Modification* disclose a crosslinked vegetable article that satisfies the conditions for the equations of the instant claims 3-4.

As noted above, Wataya and Heiko disclose the claimed invention except for specifically teaching the amount by which the moisture content index changes. However, in view of *Chemical Modification,* it would have been obvious to one having ordinary skill in the art at the

time the invention was made to adjust the initial conditions of the vegetable article and crosslinking reaction, since it has been held that the provision of adjustability, where needed, involves only routine skill in the art. *In re Stevens*, 101 USPQ 284 (CCPA 1954).

(Claims 6-9) Wataya ('319) and Heiko ('312) teach the vegetable article of Claims 3-5, wherein the vegetable article has been subjected to a crosslinking reaction by using a crosslinking agent (see above).

Wataya teaches that the vegetable article may comprise a "vegetable fiber such as palm fiber, a coconut fiber, a hemp fiber, a sponge gourd fiber, and a fiber of bamboo" *('319, translated par. [0004])*.

Heiko ('312) teaches that the vegetable article may comprise wood, e.g. spruce *('312, Working Example 1, par. [0016])*.

Therefore, Wataya and Heiko teach the vegetable article according to claims 3-5 which comprises:

a. **(Claim 6-7)** a fiber aggregate

b. **(Claims 8-9)** one kind or plural kinds selected from a leaf, a stem, a trunk and a root of a plant

Additionally, *Chemical Modification* teaches that in "addition to wood, other lignocellulosic materials of commercial value such as bamboo, kenaf, and rice straw, also lend themselves to chemical modification for use in compositions" *(Preface, page iv, par. 2; Chapter 1, Table 1, page 3)*.

Conclusion

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to APRIL C. INYARD whose telephone number is (571) 270-1245. The examiner can normally be reached on Monday - Friday 8:00 AM - 5:00 PM EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Joseph Del Sole can be reached on (571) 272-1130. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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/APRIL C INYARD/

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